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# NILLES & NILLES<sub>SC</sub>

INTELLECTUAL PROPERTY ATTORNEYS

JAMES E. NILLES  
ANDREW J. NILLES  
JAY G. DURST  
LISA M. GEHRKE  
S. MICHAEL PATTON  
LINDA E.B. HANSEN

CHARLOTTE SHAPIRO  
THADDEUS C. STANKOWSKI  
JEROME D. DRABIAK

REGISTERED PATENT AGENTS:  
MATTHEW C. LOPPNOW  
LISA A. BRZYCKI

FIRSTAR CENTER, SUITE 2000  
777 EAST WISCONSIN AVENUE  
MILWAUKEE, WI 53202-5345

TELEPHONE: 414 276.0977

FACSIMILE: 414.276.0982

EMAIL: [iplaw@nilles-nilles.com](mailto:iplaw@nilles-nilles.com)

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Commissioner of Patents  
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Washington, D.C. 20231

Re: **UTILITY PATENT APPLICATION TRANSMITTAL UNDER 37 C.F.R. § 1.53(b)**  
First Inventor or Application Identifier: Tyler E. Pease  
Title: AN INSULATED PANEL FOR COMMERCIAL OR RESIDENTIAL  
CONSTRUCTION AND METHOD FOR ITS MANUFACTURE  
Assignee: Plymouth Foam Incorporated  
Express Mail Label No. EL516556347US  
Attorney Docket No.: 141.009

Dear Sir:

Enclosed is our check in the amount of \$345.00 in payment of the government filing fee for the enclosed United States patent application, which application includes 15 pages of specification, 15 claims, Abstract of the Disclosure, 3 sheets of drawings, an executed Declaration, and a Verified Statement Claiming Small Entity Status, the original of which will be signed and delivered to the Patent Office at a later date.

Also enclosed is an Assignment, which was executed concurrently with the Declaration and which is being filed concurrently with the application, a recordation cover sheet, and our \$40.00 check in payment of the recording fee.

Respectfully submitted,



Stephen Michael Patton  
Reg. No. 36,235

Enclosures

SMP/jp

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

Justin I. Barron

Date of Deposit: August 28, 2000

Justin J. Perron

**STATEMENT CLAIMING SMALL ENTITY STATUS  
(37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN**

Docket Number: 141.009  
Applicant: Tyler E. Pease  
ApplicationNo.: not yet assigned  
Filed: concurrently herewith  
Title: AN INSULATED PANEL FOR COMMERCIAL OR RESIDENTIAL CONSTRUCTION  
AND METHOD FOR ITS MANUFACTURE

I hereby state that I am

- ☐ the owner of the small business concern identified below:  
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN: Plymouth Foam Incorporated

ADDRESS OF SMALL BUSINESS CONCERN: 1800 Sunset Drive  
Plymouth, Wisconsin 53073 USA

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.  
☐ the application identified above.  
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:

- ☒ no such person, concern, or organization exists.  
☐ each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING: Scott Roberts

TITLE OF PERSON IF OTHER THAN OWNER: President/CEO

ADDRESS OF PERSON SIGNING: 1800 Sunset Drive  
Plymouth, Wisconsin 53073 USA

SIGNATURE \_\_\_\_\_ DATE \_\_\_\_\_

# AN INSULATED PANEL FOR COMMERCIAL OR RESIDENTIAL CONSTRUCTION AND METHOD FOR ITS MANUFACTURE

## Field of the Invention

The invention relates to insulation and construction devices. More particularly, it relates to the design and manufacture of rigid foam insulating panels.

## BACKGROUND OF THE INVENTION

5 Rigid foam panels have been in wide use since the oil crisis of the early 1970's. Whether for exterior or interior use, rigid foam panels have provided an additional layer of insulation for houses and commercial buildings that, before the energy crisis, were often uninsulated, or insulated with fiberglass batting.

10 As with any new technology, rigid foam panels have been refined over the years. Originally, the panels were used as a replacement for fiberglass batting, and were cut to fit between studs. Later, sheets of rigid foam were used on the sides of houses being remodeled to add additional insulation to the exterior walls.

15 One continuing problem with the use of rigid foam panels has been their fragility as compared to other building materials, such as wood, steel, fiberglass and the like. The panels have limited tensile strength, and therefore cannot be used by themselves to support a great deal of weight on small connectors, such as nails and screws. Furthermore, the forces needed to attach nails and screws to a wall or ceiling of a house or commercial building when doing original construction or repair can quite easily damage the foam panels during installation.

20 When foam panels are used to form an insulated sheath around a wall that is being constructed, remodeled, or repaired, some of the most difficult issues are how to attach the foam panels. Since they are easily crushed, they cannot be used as an outer

surface covering by themselves, or with a coat of paint, for example. As a result, some environmentally hardened wall covering must be applied over them, such as shingles, shakes, wallboard, and wood or other paneling.

5 When rigid foam insulation is applied it must therefore permit or provide for an additional layer to be attached to it, or at least in contact with its outer surface. This problem is not a trivial one to solve, especially for interior walls in which another relatively fragile material, gypsum board, is attached. One cannot easily, and in many cases may not wish to attach the layer of wall covering directly to the wall or studs behind the rigid foam paneling. For example, when attaching interior wall  
10 covering to a concrete wall, particularly an exterior concrete wall, it is especially bad to have fasteners such as nails or screws penetrating the wall-covering passing through the rigid foam layer, and being embedded in the concrete wall. Such fasteners provide a simple channel for heat loss and for vapor or water penetration to the outer surface of the wall covering.

15 My co-pending application entitled "An Insulated Concrete Wall System And Method For Its Manufacture", filed contemporaneously with this application, describes a concrete wall system using the rigid foam panel described herein, and is incorporated by reference in this application for methods of using the panel, ways of constructing the panel, the structure and features of the panel, and all other teachings.

20 Another disadvantage to plain rigid foam sheets is their tendency to obscure the location of appropriate hanging points for the wall coverings that are subsequently attached through them to a wall. For example, once a complete sheet of rigid foam is attached to a wall, the trusses, and framing to which they were attached is completely covered up. When the subsequent layer of wall covering, such as siding or wallboard  
25 is attached, it is difficult, if not impossible to identify the location of the studs or trusses to which the foam was attached, and to which the wall covering must be attached as well. The only way to identify the location of the studs is with such tools as "stud finders", special electronic devices that can be waved in front of the wallboard to find the location of a good mounting point for the wall covering, such as  
30 the underlying studs or trusses. These devices are notoriously unreliable, sensing as they do, the presence of a stud by capacitive or inductive means. In addition, their use

requires a separate hand to move the stud finder back and forth across the front of the wall covering until a "beep" is heard or a small red light flashes. All of this happens because the rigid foam covers up the mounting locations for mounting the subsequent wall-covering layer.

- 5           What is needed is a modified rigid foam panel and an efficient method of manufacturing it that avoids some, if not all of these problems (depending upon the embodiment). It is an object of this application to provide such a panel.

### SUMMARY OF THE INVENTION

- 10           In accordance with the first embodiment of the invention, an insulated wall panel is provided including a rigid foam sheet with first and second planar sides and having first and second grooves extending substantially the full length of the sheet in a substantially parallel orientation in the first side of the sheet, a first reinforcing strip having a length, a top and a bottom, with the bottom being disposed in the first groove
- 15           and the top facing outwardly away from the first groove, wherein the first strip extends substantially the full length of the sheet, a second reinforcing strip having a length, a top and a bottom with the bottom being disposed in the second groove and the top facing outwardly away from the second groove, wherein the second strip extends substantially the full length of the sheet, a first thin reinforcing layer bonded
- 20           to the first planar side of the rigid foam sheet, and extending across the top of the first and second grooves, and a second thin reinforcing layer bonded to the second planar side of the sheet and extending across substantially an entire surface of the second planar side. The bottoms of the first and second strips may have two downwardly extending flanges that are oriented substantially perpendicular to the first planar side.
- 25           The top of the first and second reinforcing strips may be mechanically textured over the length of the first and second strips to provide an improved gripping surface for drills and self-tapping or fine-threaded wallboard screws. The top of the first and second reinforcing strips may have a plurality of holes spaced apart at predetermined intervals along the length of the first and second reinforcing strips. The top of the
- 30           first and second reinforcing strips may have a plurality of slots spaced apart at predetermined intervals along the length of the first and second reinforcing strips.

The first reinforcing layer may be bonded to the rigid foam sheet to enclose the first and second reinforcing strips and to define a first vapor barrier across substantially the entire first side of the sheet. The second reinforcing layer may be bonded to the rigid foam sheet to define a second vapor barrier across substantially the entire second side of the rigid foam sheet. The first and second reinforcing layers may have a tensile strength at least 100 times as great as the tensile strength of the rigid foam sheet. A first portion of the first reinforcing layer may extend across the top of the first reinforcing strip and be placed in tension when the panel is bent away from the first reinforcing strip before the foam sheet will fracture at the first groove. A second portion of the first reinforcing layer may extend across the top of the second reinforcing strip and may be placed in tension when the panel is bent away from the second reinforcing strip before the rigid foam sheet will fracture at the second groove.

In accordance with a second embodiment of the invention, a method of manufacturing an insulated wall panel is provided that includes the steps of creating a foam block having first and second opposing sides, cutting the foam block to form a plurality of stacked individual foam sheets having first and second sides and a plurality of parallel recesses in the first side, inserting a reinforcing strip having a top and a bottom into each of the plurality of recesses in each of the plurality of sheets, covering the tops of each of the reinforcing strips with a first thin reinforcing layer, and bonding the first reinforcing layer to the first side of each of the rigid foam sheets. The method may also include the step of bonding a second reinforcing layer to the second side of each of the rigid foam sheets. The step of cutting the foam block may include the steps of drawing a hot wire frame of substantially equally spaced parallel hot wires through the block from the first side to the second opposing side of the block, and simultaneously forming each of the plurality of grooves in the block with each of the hot wires in the hot wire frame, and completing a path through the block by substantially simultaneously separating the block into a plurality of sheets.

The step of bonding the first reinforcing layer may include at least one of the following steps: (a) applying adhesive to the first side of each of the plurality of sheets and subsequently rolling the first reinforcing layer onto the first side; (b) applying adhesive to the first reinforcing layer and subsequently rolling the first reinforcing layer onto the first sides of each of the foam sheets, and (c) rolling the first

reinforcing layer onto the first sides of the foam sheets and subsequently heating the first reinforcing layer to form a thermal bond between the first sides of the foam sheets and the first layer. The method may include the step of orienting the foam sheet with respect to a means for trimming each sheet such that there is a  
5 predetermined distance between the means for trimming and the reinforcing strips, and trimming an edge of the foam sheet.

In accordance with a third embodiment of the invention, a method of manufacturing an insulated foam panel is provide that includes the steps of continuous foaming a liquid matrix of expanding foam precursor, channeling the liquid matrix  
10 out through a nozzle, capturing the liquid matrix between two parallel and advancing thin sheets of reinforcing material, inserting a plurality of continuous webs of reinforcing strip between the two sheets of reinforcing material, maintaining the sheets in a substantially parallel spaced apart orientation as they advance over a distance sufficient to permit the liquid matrix to expand, fill substantially an entire  
15 void between the two sheets, and harden in the form of a continuously moving ribbon of insulated panel, and repeatedly and successively cutting the moving ribbon into a plurality of individual insulating panels having a cut edge substantially perpendicular to the direction of advancement. The method may include the steps of unrolling a plurality of ribbons of reinforcing material at substantially the same linear rate as the  
20 first and second sheets advance, and roll forming the plurality of unrolled ribbons into the plurality of continuous webs of reinforcing strip. The method may include the step of continuously trimming lateral opposed edges of the ribbon of insulated paneling as the ribbon advances and prior to the step of spacing the plurality of continuous webs of reinforcing strips a first predetermined distance apart. The steps  
25 of maintaining the sheets may include the step of simultaneously maintain the plurality of continuous webs of reinforcing strips at the first predetermined distance apart.



## BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 shows a plan view of an insulated panel in accordance with the present invention;

FIGURE 2 shows an end view of the panel in FIGURE 1;

5        FIGURE 3 is an end view of the reinforcing strip of the panel in FIGURES 1 and 2;

FIGURE 4 is an end view of an alternative reinforcing strip for the panel of FIGURES 1 and 2;

10       FIGURE 5 is a fragmentary plan view of the reinforcing strips of FIGURES 1-4 showing an elongated slot construction;

FIGURE 6 is a fragmentary plan view of the reinforcing strip of FIGURES 1-4 showing a mounting hole;

FIGURE 7 is a fragmentary plan view of the reinforcing strip of FIGURES 1-4;

15       FIGURE 8 illustrates an alternative arrangement of reinforcing strips for the insulated panel of FIGURE 1;

FIGURE 9 illustrates one method of forming a plurality of insulating foam sheets from a solid foam block;

20       FIGURE 10 illustrates the path followed by a hot wire in order to make the individual sheets from the foam block of FIGURE 9;

FIGURE 11 illustrates the step of removing excess material from each of the grooves formed as shown in FIGURES 9 and 10;

FIGURE 12 illustrates a first process for assembling the insulated foam panel of the foregoing FIGURES; and

FIGURE 13 illustrates an alternative process for forming the insulated foam panels of the preceding FIGURES.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

5 Referring now to FIGURES 1 and 2, an insulated foam panel 10 is shown that includes an rigid foam sheet 12 having two grooves 14, 16 into which two reinforcing strips 18 are disposed. The panel is preferably four feet wide by eight feet long (4' x 8') and between one and three inches (1"-3") in thickness. The two reinforcing strips are preferably equidistantly spaced from the center of the panel two feet (2') apart  
10 leaving a one-foot (1') margin on either side. In this manner, when the panels are placed adjacent to each other by abutting their edges in a checkerboard arrangement, a continuous expanse of equidistantly spaced reinforcing strips on two foot centers will be provided.

On the outer surfaces of panel 10 are two thin reinforcing sheets 20 and 22.  
15 The first of these, sheet 20, extends completely across the side of the rigid foam sheet approximate to the reinforcing strips. The second of these, sheet 22, extends completely across and covers the entire surface of the opposing side of the sheet.

The reinforcing layers or sheets are preferably made of plastic, paper, foil, or a combination thereof, preferably in a composite film form, if more than one material is  
20 used. The preferred plastic for the sheets is polyolefin or polyester.

Rigid foam sheet 12 may be formed of any of a variety of rigid foam materials. These materials may be thermoplastic or thermosetting foams. Preferred foam materials include polystyrene, polyisocyanurate and polyurethane. The sheet, depending on application, has a thickness of between one and three inches with a  
25 thermal resistance ("R") value of between 3 and 8 per inch of thickness.

Reinforcing strips 18 extend substantially the entire length of the panel in a parallel side-by-side arrangement. As shown in FIGURE 1, two strips are preferably provided. Alternatively, three strips (or more) can be provided as shown in FIGURE 8.

The strips preferably have a top surface 19 that is substantially coplanar with the surface of the rigid foam sheet. In this manner, when reinforcing sheets 20 and 22 are bonded to the surface of rigid foam sheet 12, the top surfaces 19 of the reinforcing strips (i.e., the outwardly facing surface of the reinforcing strips) will be adjacent to the reinforcing sheet and at substantially the same level, applied to the outer surface without lifting it up away from the surface of the sheets. With this arrangement, when subsequent layers of material, such as gypsum board, are attached to the reinforcing strip, the inner panel-facing surface of these wallboards will be flush with both the foam sheet and with the tops of the reinforcing strips.

Referring now to FIGURES 3 and 4, reinforcing strips 18 may have several different cross-sectional profiles. FIGURES 3 and 4 represent just two possible cross-sectional profiles of the strips. The embodiments of both FIGURES 3 and 4 have a central web portion 24 with two outwardly extending fins 26. As shown in FIGURE 3, these fins 26 can be rolled at their free ends to provide gripping edges 28 that can be inserted into rigid foam sheet 12 to hold reinforcing strips 18 into position. Central web 24 of the strips preferably has a recessed central portion 30 that extends substantially parallel to and slightly below (as shown in FIGURE 2) the surface of the insulated panel 10. On either side of this recessed central portion are two non-recessed portions 32 and 34 that define the topmost surface of the reinforcing strips. Portions 32 and 34 are preferably disposed coplanar with the surface of rigid foam sheet 12. By recessing a portion of the web of reinforcing strips 18, the head of a fastener 36 used to attach the panel to a wall can be completely recessed below the nominal surface of insulated panel 10.

Referring now to FIGURES 5-7, reinforcing strips 18 can be provided with a variety of surface finishes and fastening mounts. As shown in FIGURE 5, elongate slots 37 extending substantially parallel to the length of the strips can be disposed in a spaced apart arrangement over the length of the strip. As shown in FIGURE 6, holes 38 can similarly be provided along the length of the strip. As shown in FIGURE 7, the top surface of reinforcing strips 18 can be textured, such as by knurling, roll-forming, punching or stamping. This textured surface provides surface irregularities that reduce the tendency of drills or self-tapping screws to wander when they are drilled through reinforcing strip 18.

There are several ways of making insulated panels in accordance with this invention. FIGURES 9-11 and 13 show one method for making insulated panel 10, and FIGURE 12 shows another preferred method.

Referring now to FIGURE 9, a foam block 40, typically having outer dimensions on the order of three feet by four feet by eight feet (3' x 4' x 8') is cut into a stack of rigid foam sheets using a hot wire frame. Each of the joints between the stacked foam sheets 12 shown in FIGURE 9 is formed by a hot wire or ribbon following the path shown in FIGURE 10. These wires, in order to form a plurality of insulated foam sheets having a constant thickness, are about eight feet (8') long and are spaced equidistantly apart. Their spacing is preferably equal to the desired thickness of the rigid foam sheets. The wires are parallel to each other and lie in a plane. At their ends, they are attached to a frame that holds them in this orientation. The wires are heated and the frame is advanced until all the wires contact side 42 of block 40. The frame is translated through the block such that all the wires follow the path shown in FIGURE 10, simultaneously forming the first grooves 14 in the partially separated block then returning to their original path 44 as the frame traverses block 40 until the second groove 16 is formed by the wires following path 44 as shown in FIGURE 10. Once the second groove is formed, the wires again return to their original path 44 and continue until they all substantially simultaneously exit side 43 of the foam block 40 and each of the rigid foam sheets 12 are substantially simultaneously separated from each other.

When this cutting process is complete, a stack of individual foam sheets is produced as shown in FIGURE 9. Each of the rigid foam sheets includes two long strips of rigid foam 46 that must be removed from each of the sheets as shown in FIGURE 11.

While this is the preferred process, an alternative process could use the same frame of hot wires that travel along a straight line through block 40 to form a stack of sheets each sheet having two smooth opposing surfaces and no recesses 14 and 16. In this process, once the sheets have been formed, they can be separated and have their grooves 14, 16 formed individually and sequentially on each sheet. Preferably, two hot knives, ribbons, wires, rolls, or a milling cutter will be drawn down the length of

each sheet 12 simultaneously forming the two grooves 14 and 16 starting at one end of each rigid foam sheet 12 and traveling the length of that sheet until the two groove-forming tools reach the other opposing end of the sheet in a single pass that forms both recesses simultaneously. The path followed by the tool making the recess is preferably parallel to the longitudinal extent of the recesses in this method.

FIGURE 13 illustrates a continuation of the panel forming process that started in FIGURES 9-11. In FIGURE 13, a panel is shown in various steps of its assembly and manufacture starting at the left and proceeding in the direction of the arrows to the right side of the FIGURE. In the center of the FIGURE are three alternative processes, 49A, 49B, 49C, each of which are suitable for applying the reinforcing sheets to the rigid foam sheet 12. In step 48, two reinforcing strips 18 are inserted into grooves 14, 16 in the rigid foam sheet 12. Once the strips are inserted into the sheet, the reinforcing sheets 20, 22 are applied to each side of the rigid foam sheet 12.

In step 49A, adhesive-dispensing nozzles 50, 52 apply adhesive to reinforcing sheet material being drawn off two rolls 54 and 56. Rigid foam sheet 12 with reinforcing strips 18 inserted is then moved between these rolls and the adhesive-coated reinforcing sheet material is unrolled applied to the opposing surfaces of the rigid foam sheet 12.

In alternative step 49B, located in the center of FIGURE 13, two adhesive dispensing nozzles 58, 60 apply an adhesive directly to both sides of the rigid foam sheet 12 itself, and reinforcing sheet material on two rolls 62, 64 is subsequently rolled onto the rigid foam sheet 12 as it moves rightward.

In step 49C, located at the bottom of FIGURE 13, no adhesive is applied and the rigid foam sheet 12 is covered on both sides with the reinforcing sheet material that is held on rolls 66, 68.

In step 70, two heated rollers or sheets 72 and 74 are pressed against both sides of the sheet to either (a) cure the adhesive previously applied in steps 49A and 49B, or to (b) thermally bond reinforcing sheets 20, 22 to the rigid foam sheet 12 previously assembled in step 49C. Once this heating is complete, the completely assembled insulated foam panel 10 is removed as shown in step 76.

Nozzles 50, 52, 58 and 60 that are used to apply adhesives, preferably apply an even layer of adhesive across the entire face of either the reinforcing sheet 20, 22 or the rigid foam sheet 12 as shown in steps 49A and 49B. In this manner, the bond preferably extends across the entire interface between the reinforcing sheets 20, 22 and the rigid foam sheet 12.

In an alternative embodiment, any or all of the nozzles may apply glue to an intermediate roller that is thereby covered with glue. This intermediate roller will then transfer the glue to the rollers shown in the FIGURES by rolling contact.

The process shown in FIGURE 13 illustrates the formation of the most complete and preferred embodiment of this invention. As noted above, there may be different numbers of reinforcing strips, not just two as shown in FIGURE 13, that are inserted into the rigid foam sheet 12. In addition, one of the reinforcing sheets need not be applied.

Finally, although steps 49A-49B show adhesive applied to either both sides of the rigid foam sheet 12 (step 49B) or to both sheets of reinforcing sheet material (49A). It should be understood that these two processes can be combined, so that one side of the rigid foam sheet 12 is covered with an adhesive coated reinforcing sheet and the other side of the rigid foam sheet 12 has adhesive applied directly to it.

FIGURE 12 shows a continuous process of forming insulating wall panels. In this embodiment, a nozzle 80 directs a flow of a liquid matrix 81 of expandable foam precursor such that it forms a thin, wide sheet, preferably on the order of four feet wide. The liquid matrix flows between two reinforcing sheets 20, 22 unrolled by rollers 82 and 84. A plurality of metallic reinforcing strips, such as those shown and described above, are roll-formed by rollers 86 from thin, flat sheet stock on roll 88 and are inserted adjacent to the top or the bottom (as shown here) of the liquid matrix. The sheets and the foam in between them as well as the reinforcing strips are advanced through the machine between two sheet supports 90, 92, each of which may be shoes, such as shown here, or an endless belt loop supported by rollers. These sheet supports constrain and support the liquid matrix as it cures to rigid foam. By varying the spacing of the sheet supports, insulated panels of several thicknesses may be made using the same machine.

Once the composite structure reaches the end 94 of the supports, the foam has cured and the panel is substantially rigid. This continuous sheets of paneling is then cut to discrete lengths by a flying cutter 96, disposed after the end 94 of the supports.

5 In an alternative embodiment, nozzles 80 can direct the flow of foam beads or pellets instead of a liquid matrix. In this alternative embodiment, sheets supported 90, 92 are preferably heated by steam to cause the beads or pellets to expand and bond to each other to form the foam core of the panel. An example of a machine illustrating this foam bead or pellet process for forming a sheet can be seen in U.S. Patent Nos. 4,379,107 and 5,786,000.

10 While those skilled in the art may recognize other ways in which the present application may be useful, this application is not to be limited by the descriptions given above, but is to be limited solely by the scope of the claims that follow.

WHAT IS CLAIMED IS:

- 1           1.       An insulated wall panel, comprising:  
2                   a rigid foam sheet with first and second planar sides and having first  
3                   and second grooves extending substantially the full length of the sheet in a  
4                   substantially parallel orientation in the first side of the sheet;  
5                   a first reinforcing strip having a length, a top and a bottom with the  
6                   bottom being disposed in the first groove and the top facing outwardly away from the  
7                   first groove, wherein the first strip extends substantially the full length of the sheet;  
8                   a second reinforcing strip having a length, a top and a bottom with the  
9                   bottom being disposed in the second groove and the top facing outwardly away from  
10                  the second groove, wherein the second strip extends substantially the full length of the  
11                  sheet;  
12                  a first thin reinforcing layer bonded to the first planar side of the sheet,  
13                  and extending across the top of the first and second grooves and substantially  
14                  covering the entire first planar side of the sheet; and  
15                  a second thin reinforcing layer bonded to the second planar side of the  
16                  sheet and extending across substantially an entire surface of second planar side.
- 1           2.       The insulated wall panel of claim 1, wherein the bottoms of the first  
2                   and second strips each have two downwardly extending flanges that are oriented  
3                   substantially perpendicular to the first planar side.
- 1           3.       The insulated wall panel of claim 2 wherein the top of the first and  
2                   second reinforcing strips are mechanically textured over the length of the first and  
3                   second strips to provide an improved gripping surface for drills and self tapping  
4                   screws.
- 1           4.       The insulated wall panel of claim 2, wherein the top of the first and  
2                   second reinforcing strips have a plurality of holes spaced apart at predetermined  
3                   intervals along the length of the first and second reinforcing strips.
- 1           5.       The insulated wall panel of claim 2, wherein the top of the first and  
2                   second reinforcing strips have a plurality of slots spaced apart at predetermined  
3                   intervals along the length of the first and second reinforcing strips.



1           6.       The insulated wall panel of claim 2, wherein the first reinforcing layer  
2 is bonded to the rigid foam sheet to enclose the first and second reinforcing strips and  
3 define a first vapor barrier across substantially the entire first side of the sheet.

1           7.       The insulated wall panel of claim 6, wherein the second reinforcing  
2 layer is bonded to the rigid foam sheet to define a second vapor barrier across  
3 substantially the entire second side of the sheet.

1           8.       The insulated wall panel of claim 7, wherein the first and second  
2 reinforcing layers have a tensile strength at least 100 times as great as the tensile  
3 strength of the foam sheet.

1           9.       The insulated wall panel of claim 8, wherein a first portion of the first  
2 reinforcing layer extending across the top of the first reinforcing strip is placed in  
3 tension when the panel is bent away from the first reinforcing strip before the foam  
4 sheet will fracture at the first groove.

1           10.      The insulated wall panel of claim 8, wherein a second portion of the  
2 first reinforcing layer extending across the top of the second reinforcing strip is placed  
3 in tension when the panel is bent away from the second reinforcing strip before the  
4 foam sheet will fracture at the second groove.

1           11.      A method of manufacturing an insulated wall panel, comprising the  
2 steps of:

3                   creating a rigid foam block having first and second opposing sides;  
4                   cutting the foam block to form a plurality of stacked individual foam  
5 sheets having first and second sides and a plurality of parallel recesses in the first  
6 side;

7                   inserting a reinforcing strip having a top and a bottom into each of the  
8 plurality of recesses in each of the plurality of sheets;

9                   covering the tops of each of the reinforcing strips with a first thin  
10 reinforcing layer;

11                  bonding the first reinforcing layer to the first side of each of the foam  
12 sheets.

1           12.     The method of claim 11, further comprising the steps of:  
2                     bonding a second reinforcing layer to the second side of each of the  
3     foam sheets.

1           13.     The method of claim 12, wherein the step of cutting the foam block  
2     includes the steps of:  
3                     drawing a hotwire frame of substantially equally spaced parallel hot  
4     wires through the block from the first side to the second opposing side of the block;  
5                     simultaneously forming each of the plurality of grooves in the block  
6     with each of the hot wires in the of the hotwire frame; and  
7                     completing a path through the block by substantially simultaneously  
8     separating the block into the plurality of sheets.

1           14.     The method of claim 11, wherein the step of bonding the first  
2     reinforcing layer includes at least one of the following steps:  
3                     (a) applying adhesive to the first side of each of the plurality of sheets  
4     and subsequently rolling the first reinforcing layer onto the first side;  
5                     (b) applying adhesive to the first reinforcing layer and subsequently  
6     rolling the first reinforcing layer onto the first sides of each of the foam sheets; and  
7                     (c) rolling the first reinforcing layer onto the first sides of the foam  
8     sheets and subsequently heating the first reinforcing layer to form a thermal bond  
9     between the first sides of the foam sheets and the first layer.

1           15.     The method of claim 11, further comprising the steps of:  
2                     orienting the foam sheet with respect to a means for trimming each  
3     sheet such that there is a predetermined distance between the means for trimming and  
4     the reinforcing strips, and trimming an edge of the foam sheet.

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1           16.     A method of manufacturing an insulated foam panel, comprising the  
2 steps of:  
3                 forming a liquid matrix of expandable foam precursor;  
4                 channeling the liquid matrix out through a nozzle;  
5                 capturing the liquid matrix between two parallel and advancing thin  
6 sheets of reinforcing material;  
7                 inserting a plurality of continuous webs of reinforcing strip between  
8 the two sheets of reinforcing material;  
9                 maintaining the sheets in a substantially parallel, spaced-apart  
10 orientation as they advance over a distance sufficient to permit the liquid matrix to  
11 expand, fill substantially an entire void between the two sheets and harden in the form  
12 of a continuously moving ribbon of insulated paneling; and  
13                 repeatedly and successively cutting the moving ribbon into a plurality  
14 of individual insulating panels having a cut edge substantially perpendicular to the  
15 direction of advancement.

1           17.     The method of claim 16, further comprising the steps of:  
2                 unrolling a plurality of ribbons of reinforcing material at substantially  
3 the same linear rate as the first and second sheets advance; and  
4                 roll-forming the plurality of unrolled ribbons into the plurality of  
5 continuous webs of reinforcing strip.

1           18.     The method of claim 17, further comprising the step of:  
2                 continuously trimming lateral opposed edges of the ribbon of insulated  
3 paneling as the ribbon advances and prior to step of repeatedly and successively  
4 cutting.

1           19.     The method of claim 17, wherein the step of inserting includes the  
2 steps of:  
3                 spacing the plurality of continuous webs of reinforcing strips a  
4 predetermined first distance apart.

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### ABSTRACT OF THE DISCLOSURE

A method and apparatus for making an rigid foam insulating panel is disclosed. The panel includes an rigid foam sheet with a plurality of grooves or recesses in which reinforcing strips are placed. Both sides of the sub-assembly are covered with a reinforcing sheet made of plastic, paper, foil, or a combination thereof. These reinforcing sheets are bonded to the surface of the rigid foam sheet and provide structural support to the sheet, as well as retaining the reinforcing strips in place. They also provide a vapor barrier on both sides of the sheet to prevent the migration of moisture through the sheet toward the wall covering, which will typically be attached to the side of the sheet in which the reinforcing strips are inserted.

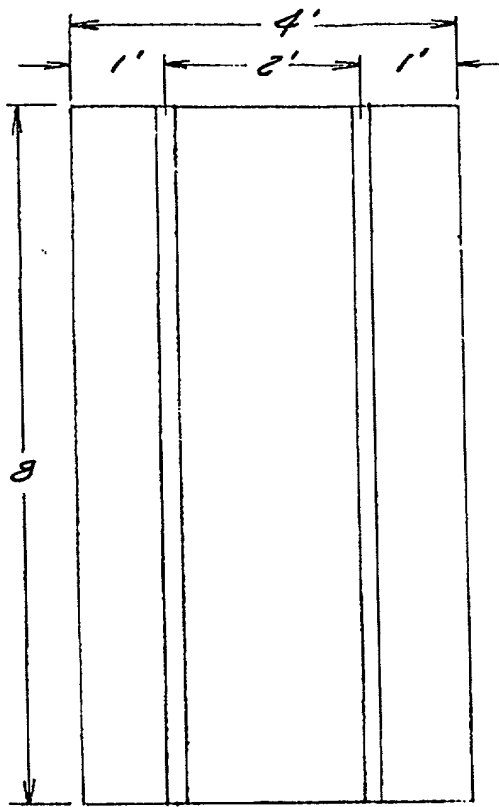


FIG. 1

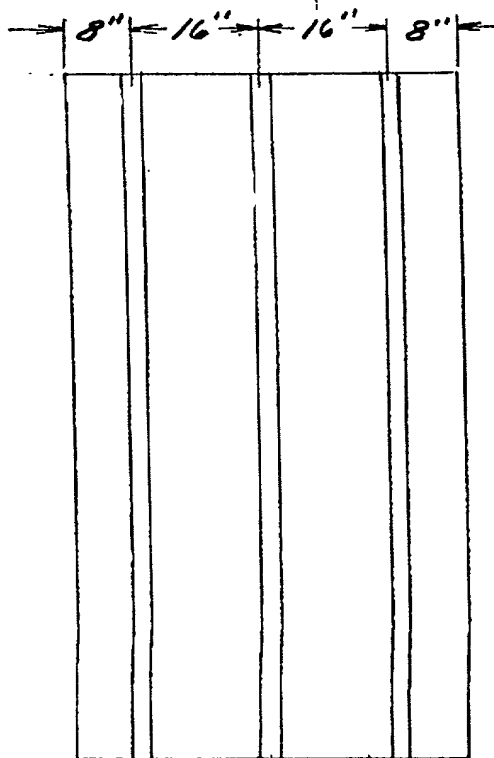


FIG. 8

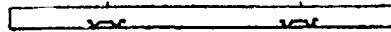


FIG. 2

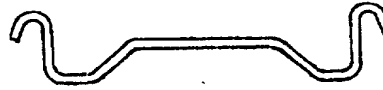


FIG. 3



FIG. 4

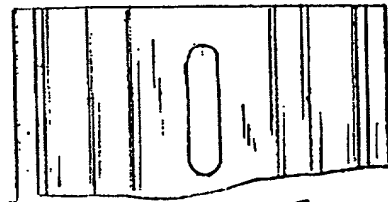


FIG. 5

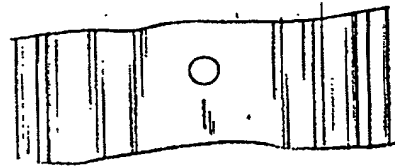


FIG. 6

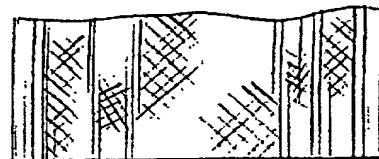


FIG. 7

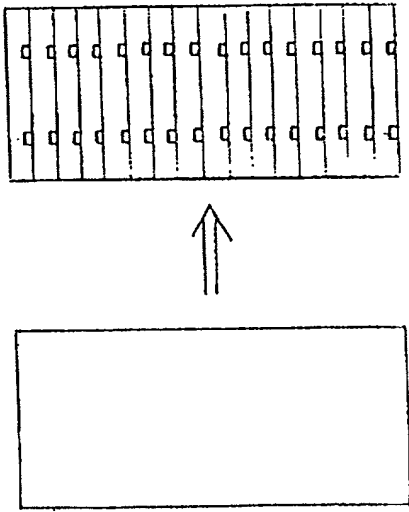


FIG. 9



FIG. 10

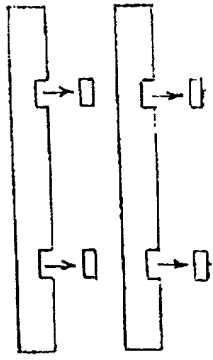


FIG. 11

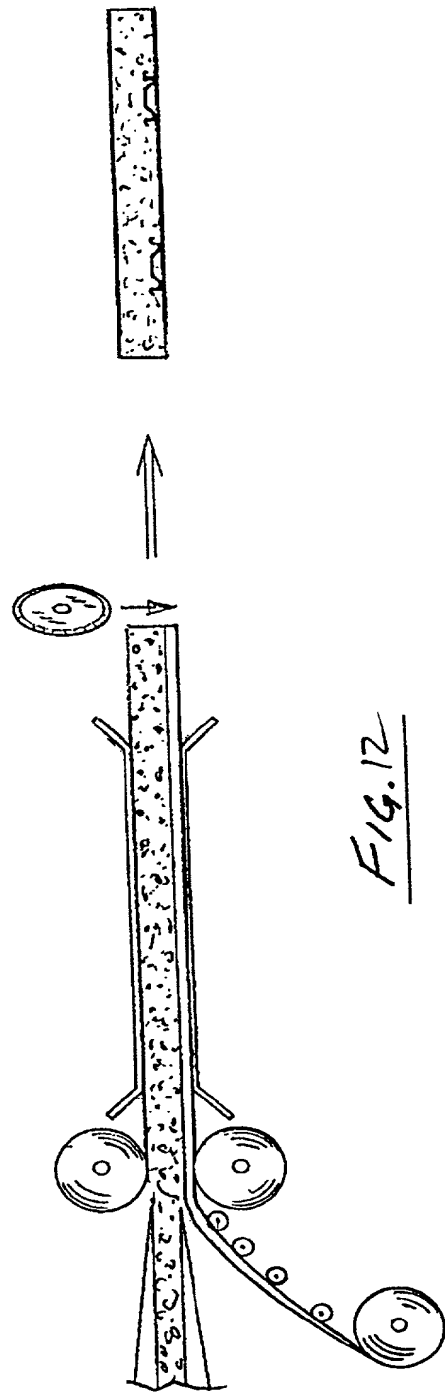


FIG. 12

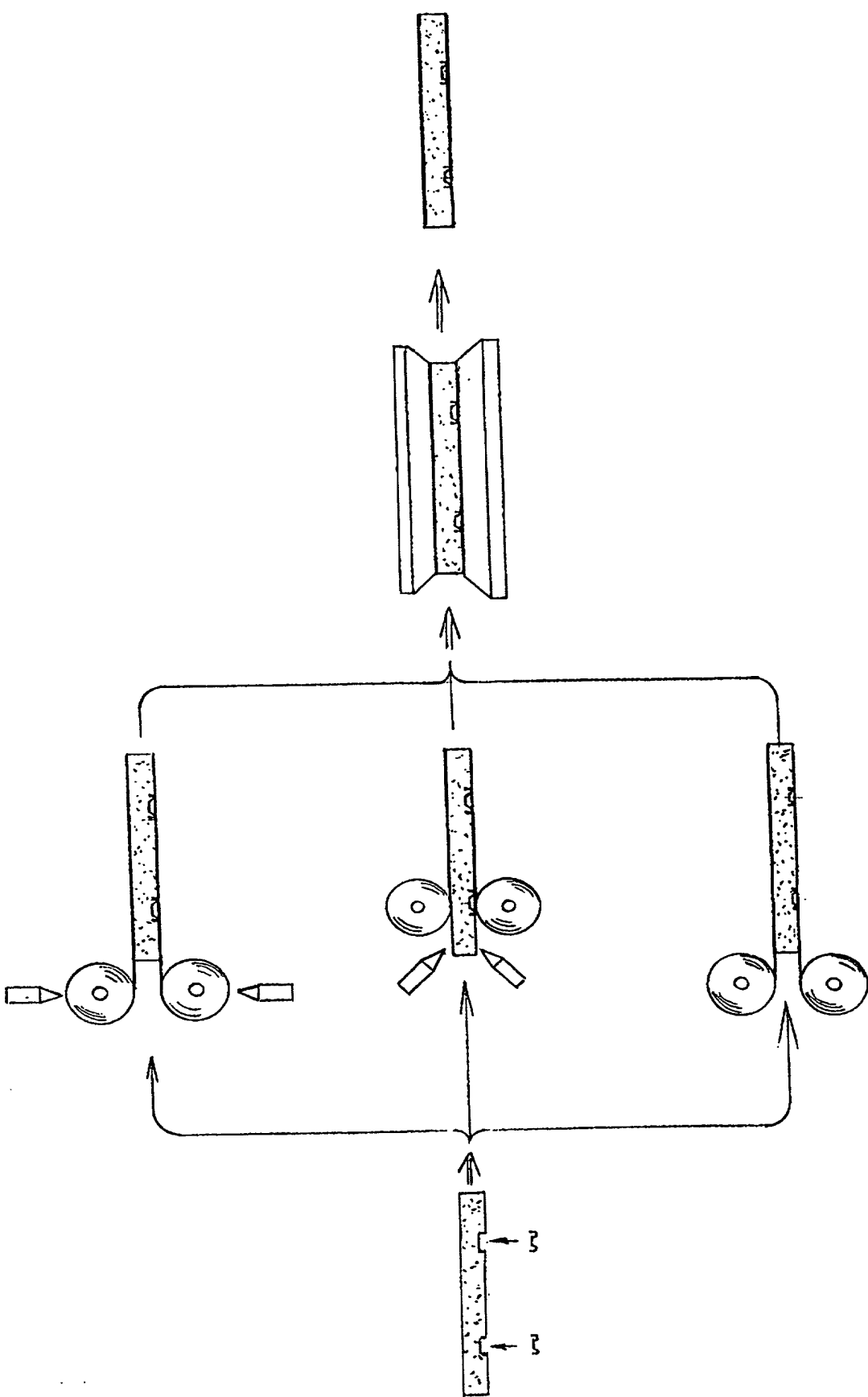


FIG. 13



**DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION**  
**(37 CFR 1.63)**

☒ Declaration Submitted with Initial Filing

**OR**

☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required)

**Attorney Docket Number: 141.009**

**First Named Inventor: Tyler E. Pease**

**COMPLETE IF KNOWN**

Application Number: not yet assigned

Filing Date: concurrently herewith

Group Art Unit: \_\_\_\_\_

Examiner Name: \_\_\_\_\_

**As a below named inventor, I hereby declare that:**

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed and for which a patent is sought on the invention entitled:

**AN INSULATED PANEL FOR COMMERCIAL OR RESIDENTIAL CONSTRUCTION AND METHOD FOR ITS MANUFACTURE**

the specification of which

☒ is attached hereto

OR

☐ was filed on \_\_\_\_\_ as United States Application Number or PCT International Application Number  
\_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)–(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not  
Claimed

Certified Copy  
Attached?

\_\_\_\_\_  
(Number) (Country) (Month/Day/Year Filed)

☐

☐ Yes ☐ No

\_\_\_\_\_  
(Number) (Country) (Month/Day/Year Filed)

☐

☐ Yes ☐ No

\_\_\_\_\_  
(Number) (Country) (Month/Day/Year Filed)

☐

☐ Yes ☐ No

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

\_\_\_\_\_  
(Application Number) (Month/Day/Year Filed)

\_\_\_\_\_  
(Application Number) (Month/Day/Year Filed)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

## DECLARATION – Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to the patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Application(s)

(Number)	(Month/Day/Year Filed)	(Patent Number (if applicable))
(Number)	(Month/Day/Year Filed)	(Patent Number (if applicable))

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

James E. Nilles, Reg. No. 16,663  
Andrew J. Nilles, Reg. No. 31,786  
Jay G. Durst, Reg. No. 41,723  
Lisa M. Gehrke, Reg. No. 38,888  
Stephen Michael Patton, Reg. No. 36,235

Thaddeus C. Stankowski, Reg. No. 45,522  
Matthew C. Loppnow, Reg. No. 45,314  
Jerome D. Drabiak, Reg. No. 31,011  
Lisa A. Brzycki, Reg. No. 40,926

Direct all telephone calls to S. Michael Patton at telephone number (414) 276-0977, facsimile number (414) 276-0982.

Direct all correspondence to: Andrew J. Nilles  
NILLES & NILLES, S.C.  
Firstar Center, Suite 2000  
777 East Wisconsin Avenue  
Milwaukee, Wisconsin 53202-5345

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**Full name of Sole or First Inventor:**

☐ A petition has been filed for this unsigned inventor

Given Name (first & middle (if any)) & Family Name/Surname: Tyler E. Pease

Inventor's Signature: Tyler E. Pease

Date: 24-August, 2000

Residence (city, state, country): Plymouth, Wisconsin 53073 USA

Citizenship: United States

Post Office Address: 1800 Sunset Drive

(city, state, zip, country): Plymouth, Wisconsin 53073 USA